the judicious use of rodenticides, new technological developments in this arena will carry a price tag for such innovations and solutions.

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Hantaviruses in the Western Hemisphere: A Review

Several hantaviruses can be found throughout the Western Hemisphere. Some of these New World hantaviruses are etiologic agents of hantavirus pulmonary syndrome, an often fatal zoonotic disease. Several species of rodents belonging to the family Muridae are the primary hosts of New World hantaviruses. Through years of research, multiple workers have indicated that each hantavirus typically has a single primary rodent host (e.g., the deer mouse, *Peromyscus maniculatus,* is the host of Sin Nombre virus); however, multiple workers have documented antibodies to a hantavirus in rodent species not known to be a primary host of a hantavirus. In this talk, virus/host relationships, transmission cycles, and risks to humans are reviewed for hantaviruses found in the New World.

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Sero-survey for Antibodies to Flaviviruses in Wild Mammals in Central and Eastern United States

Sero-surveys were conducted to detect antibodies to flavivirues and West Nile virus (WNV) in wild mammals. Two different monoclonal antibodies (6B6C-1 and 3.1112G) were used. More than 500 serum samples from over twenty mammal species captured in five states (CO, LA, NY, OH, and PA) were screened. Sera samples containing antibodies to flaviviruses were screened for WNV-specific antibodies and confirmed with plaque reduction neutralization tests. Antibodies to flaviviruses were detected in multiple species. This number was significantly reduced for WNV as was the overall prevalence of antibodies, indicating that multiple flaviviruses may have been present at some study sites. High prevalence rates for WNV antibodies were noted among raccoons, Virginia opossums, fox squirrels ,and eastern gray squirrels. **[POSTER]**

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Rodent Control Techniques: Can We Learn from Agricultural Uses?

Rodents are controlled in many different agricultural settings. While the primary reason for these programs is to reduce economic damage, the overall goals are similar to many rodent control efforts for conservation of wildlife or natural resources. Since most agricultural rodent control programs are based, or at least theoretically conceived, on a cost/benefit model, the control is done when it is economic for the producer. In conservation efforts, the same model is used but the control threshold is likely at a different level. While eradication is often the goal in conservation efforts, it is seldom the definition of success in agricultural situations. However, much effort and research on agricultural rodent control is focused on improving efficacy; making the pest control goals for agricultural and conservation much the same. In this presentation, I will review some baits (include their composition), baiting strategies and application equipment that are all used in agriculture to improve the efficacy of the control program while reducing primary and risks to non-target species. An understanding of these will help in efforts to deal with uncommon rodent pest species or control efforts in unique non-agricultural type environments.

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Benefit-Cost Analysis of Rodent Control for Conservation

Noticeably absent from most rodent damage management studies is a benefit-cost analysis (BCA) to provide an accurate estimate of total damages and justification of damage management efforts. BCA of rodent control involves comparing all of the gains and losses from a given rodent damage management action or technique in similar units; thereby providing a picture of the total gains and losses to society. The costs of rodent control include costs for bait, labor and machinery and are usually contingent on the timing of the baiting (e.g. outbreak situations). Direct benefits of rodent control incorporate reduced damage to crops, facilities, electrical systems, feed, etc. Indirect benefits could include reduced spread of disease and intangible benefits can include things like reduced mental stress as a result of rodent plagues. An example highlighting the protection of the endangered Puerto Rican parrot (*Amazona vittata*) from predation by the black rat (*Rattus rattus*) illustrates the importance of BCA in studies examining rodent control for conservation. With increased efforts for island rodent eradication programs to aid in the recruitment of shore birds, the use of BCA is imperative.

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Preventing Rat Introductions to the Pribilof Islands, Alaska, USA

The Pribilof Islands have about three million nesting seabirds, a million northern fur seals, an endemic shrew, and other wildlife. Rat introduction would greatly reduce bird and shrew populations and might transfer diseases to humans and wildlife. The islands have been inhabited since 1786, and although the lack of harbors impeded rodent introduction, house mice became established on St. Paul in 1872. In the early 1990's, harbors were constructed on both St. George and St. Paul Islands. A boom of commercial fisheries soon followed and eventual rat introduction seemed a certainty. With the objective of keeping the Pribilofs rat free, a prevention program was begun in 1993 based on cooperation with local communities, government agencies, and industry. The program consists of maintaining trap and poison stations, community education, local shipwreck response capabilities, outreach to make ships rat free, and regulations. Over a million trap nights have passed and six rats have been killed on the St. Paul docks, but there is no evidence of rats becoming established anywhere in the Pribilof Islands. Improved design of preventive stations has decreased maintenance needs. Snap traps have been more effective than poisons, but have caused some non-target loss (winter wrens). Both techniques are recommended. The local communities are taking increasing ownership in the program and it appears that fewer ships using the Pribilof Islands carry rats. Unless there is a major advancement in rodent removal technology, the prevention program will have to be continued indefinitely. It is too early to be certain that the program is adequate to protect the Pribilof Islands, but as each rat-free year passes, hopes are rising. Technical advice from Rowley Taylor, Joe Brooks, and Paul O'Neil was instrumental in the initiation of this program. **[POSTER]**

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Preventing Rat Spills on U.S. Alaska Maritime National Wildlife Refuge: A Preliminary Approach

Shipwrecks have caused rodent introductions world wide and continue to be a threat. The first documented rat introduction on Alaska Maritime NWR occurred in 1780 when a Japanese ship went aground on what would later be renamed Rat Island. The Alaska Maritime NWR is responsible for conserving the unique ecosystems and biodiversity of about 3.5 million acres, including the Aleutian Islands International Biosphere Reserve—a special designation in recognition of the uniqueness of the region on a global scale. Prevention of further introductions is of primary concern and should be the cornerstone of any invasive species program. Stopping introductions is both more ecologically effective and cost-efficient. The Refuge established a shipwreck response team in 1995 in an effort to protect over 2,000 islands, rocks and spires spread across 2,500 miles of the Great Circle trade route from rodent introductions. To date, many incidents involving ships in distress have occurred, though actual field responses have been limited to four. Fortunately, none of these ship casualties had rats. Efforts are now underway to improve response capabilities, expand partnerships and enlarge the area for which rat spill response is possible. Questions remain about the most effective ways to stop rat invasions from shipwrecks including appropriate rodenticides and other methods of killing rats, delivery methods, and relevant rat behavior before and after they leave wrecks. **[POSTER]**

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Developing a Rat-IPM Technology for the Philippine Irrigated Rice Lowland Ecosystem

The rat population dynamics were monitored using the trap barrier system+trap crop (TBS+TC) for four rice cropping seasons in 2002-2004 while their movement to and from the rice field by the linear TBS during the dry season 2004 under the Philippine irrigated lowland conditions. High rat catches were recorded during the period of field operation up to the vegetative stage of the rice plant. At this period, more female rats moved to and from the rice field than the males, but not during the rice reproductive stages. About 12% of the female rats that moved into the rice field at rice vegetative stage were juveniles and the rest had either mated or given birth. At the rice reproductive stages, most have either given birth or lactated before or during the period. The decline in female rat movement at the later stages of rice growth may be related to its nursing activities, protection of the pups, and availability of food nearby. However, additional data is needed to satisfactorily explain these assumptions. Nevertheless, the results indicate that the best time to conduct a community-wide physical rat control system to reduce the initial rat population is at the early stages of the cropping season. Other control measures, like baiting may also be focused at this period and not throughout the cropping period as currently practiced by the farmers to reduce cost and risk. Detailed information on burrow census in and around the rice field, rat sexual status at different rice growth stages, and other related information were to be considered in the continuing study. **[POSTER]**

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The Eradication of Introduced Roof Rats on the U.S. Buck Island Reef National Monument, St. Croix, U.S. Virgin Islands

The U.S. National Park Service and USDA/APHIS Wildlife Services made a planned and sustained effort to eradicate the introduced roof rats (*Rattus rattus*) from Buck Island Reef National Monument in the Caribbean Sea from 1998-2000. The rats were causing substantial damage to a variety of the Island's floral and faunal resources. The WS created an island-wide grid of elevated bait stations and used an anticoagulant (0.005% diphacinone) rodenticide bait block to eradicate the rats. The bait stations were modified several times to assure ready access by rats while minimizing access by non-target animals. Several post-project trapping sessions resulted in no rat captures, suggesting that, indeed, the rats had been eradicated from the Island. No non-target losses resulting from the baiting program were observed by field personnel, but they noted what appears to be a rapid recovery of many of the Island's floral and faunal resources. A post-eradication rodent monitoring protocol has been implemented. Post-project monitoring sessions revealed the presence of a growing house mouse (*Mus musculus*) population on the Island. The threats posed by, and potential management strategies for, this introduced pest species are being investigated.

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Leptospirosis in the Azores: The Rodent Connection

The Azores are Portuguese islands in the North Atlantic Ocean. The culture is very agrarian with a large cattle industry. Unfortunately, there is a chronic leptospirosis problem within the people, livestock, companion animals, and wildlife of the Azores. Introduced rodents (*Rattus rattus, R. norvegicus, Mus musculus*) play a significant role as maintenance hosts of this disease. We review the situation and make recommendations for reducing the occurrence and hazard of leptospirosis in the Azores. Areas addressed include the need for a better understanding of the epidemiology of the disease and the role of rodents, development of an effective rodent control program, improvements in farm practices and animal husbandry, and improvements in the Azores infrastructure to effectively reduce the leptospirosis hazard.

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Are Both Rat Species, *Rattus rattus* and *R. norvegicus*, Omnivorous?

The roof rat (*Rattus rattus*) complex as well as the Norway rat (*R. norvegicus*) are often called omnivores. However, the food habits of the roof rat are different from those of the Norway rat. In this survey, roof rats mainly ate plant materials and the average volume percentage of their stomach contents was usually over 90% with seeds and fruits being more than one-third of those plant materials. The rest of the contents were mainly insects. As for Norway rats, the volume percentage of plant materials in the stomach contents varied by study sites and was between 14-74% on average. The rest of the contents were animal materials such as insects,

annelids, snails, and fish. Therefore, the roof rat chose far more plant materials than animal materials as food, whereas the Norway rat chose both of them in similar volumes.

The roof rats, however, showed unusual food habits when they were thirsty or food was in short supply. Roof rats on a desert island covered with volcanic ash in Japan preferred succulent herbaceous stems (53.2% in volume) to seeds (28.8%) probably to increase water uptake. In another case, roof rats on a remote island of southern Japan ate bark and an excessive amount of insects when starving. Rat stomach contents included 44.1% of animal materials (chiefly insects) and 8.9% of soft tissues of Citrus tankan bark on average in volume. It is supposed that this unusual food habit is caused by food shortage after a population outbreak. In conclusion, it appears that the roof rat complex is basically herbivorous and the Norway rat is basically omnivorous, although the roof rat changes food habits when it is thirsty or food is in short supply.